Exhibit W

84-1162

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ETHICON RESEARCH FOUNDATION
SOMERVILLE, NEW JERSEY 08876

To: Dr. R. L. Kronenthal

May 2, 1984

cc: Dr. A. W. Fetter
Mr. G. G. Jones
Dr. A. J. Levy
Mr. R. Lilenfeld
Dr. D. C. Marshall
Dr. A. Melveger
Mr. R. Reinhardt
RDCF

Subject: EXAMINATION OF PROLENE* (POLYPROPYLENE) SUTURES FROM HUMAN CARDIOVASCULAR EXPLANTS

ERF ACCESSION NO.

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PROJECT NO. 16104

SUMMARY

Six, formalin fixed tissue explants, containing PROLENE suture were received for evaluation of surface cracking and tensile strength measurement. Samples 1-5 were received from Dr. Margaret Bellingham, Stanford University Medical Center, and had PROLENE suture in residence from 1 year 2 months to 4 years 3 months post-op, size 3-0 and 4-0. Sample 6, size 5-0, was sent by Dr. Richard Sanders, Denver Colorado and had PROLENE in residence for 7 years.

Continuous PROLENE suture lines were carefully removed from the fixed cardiovascular specimens while keeping sutures wet. Subsequently, sutures were examined by light microscopy while wet and dry. Histological preparations of PROLENE cross-sections in tissue were stained in Phloxine and examined for cracking. Sample 1-5 showed no surface cracking in light microscopic examinations of both explanted suture or histological sections. Sample 6 displayed severe surface cracking of a 3 to 4.5 micron layer as measured in histological cross-sections.

The average breaking strength remaining for size 3-0 was 76.5% (range 47% - to 93%) and for size 4-0 was 98.25% (range 86% - 110%) when compared to similar size controls. Only one length of 5-0 PROLENE was available for tensile strength measurement indicating 76% strength remaining for the 7 year specimen.

Reported by Barbara Matlaga 5/2/84
B. Matlaga, B.S., ASCP(MT)

Approved by W. D. Sheffield 5/2/84
W. D. Sheffield, V.M.D., Ph.D.

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PURPOSE

The purpose of this study was to evaluate PROLENE suture removed from human cardiovascular explants for evidence of surface cracking.

MATERIALS

The following samples of formalin fixed cardiovascular tissues were received. Each contained multiple PROLENE suture lines.

Sample Number	Tissue Type	Years Post-Op
1	Aorta Pulmonary Artery & Right Atrium	1 year, 2 months
2	Aorta Pulmonary Artery & Right Atrium	4 years, 3 months
3	Aorta Pulmonary Artery & Right Atrium	1 year, 5 months
4	Aorta Pulmonary Artery & Right Atrium	2 years
5	Aorta Pulmonary Artery & Right Atrium	1 year, 2 months
6	Dacron Graft	7 years

Sample 1-5 were received from Dr. Margaret Bellingham, Stanford University Medical Center via Mr. Garf Jones (see attached letter Jones to Block, 10/21/83). Sample 6 was sent from Dr. Richard J. Sanders of Denver, Colorado via Mr. Ron Reinhardt (see attached letter Reinhardt to Marshall, 2/4/84).

METHODS

Each tissue specimen was removed from the formalin solution and rinsed with distilled water. Thereafter, samples remained wet. PROLENE suture was carefully dissected out of the tissue specimens and kept wet in distilled water until examinations could be performed. Pieces of tissue containing cross-sections of PROLENE suture were submitted for histological preparation and staining with 1% aqueous Phloxine solution to enhance the visualization of the cracked layer.

The surface of each strand of PROLENE suture was examined by light microscopy while wet and selected photographs were taken. The specimens were then allowed to air dry and re-examined for surface cracking. Selected photographs were taken of the appearance of identical areas in wet and dry conditions. Each specimen was then sized using a micrometer and appropriate lengths were tested on the Instron for breaking strength against similar-sized controls. The following suture lots were used as controls: size 3-0, lot no. QB2FJT, size 4-0, lot no. RH2CZN and size 5-0, lot no. MQ0287.

RESULTS

The results are listed in the table below.

Sample Number	PROLENE Suture Size	Length of Residence	Surface Cracking	Size / % Strength Remaining*
1	3-0, 4-0	1 yr., 2 mos.	no	4-0 / 106%
2	4-0	4 yr., 3 mos.	no	4-0 / 86%
3	3-0, 4-0, 5-0	1 yr., 5 mos.	no	3-0 / 75% 4-0 / 90%, 102%
4	3-0, 4-0	2 yr.	no	3-0 / 93%, 47%, 91% 4-0 / 94%, 92%, 110%
5	3-0, 4-0	1 yr., 2 mos.	no	4-0 / 106%
6	5-0	7 yr.	yes	5-0 / 76%

* Lists individual data for each strand tested against a similar sized control.

Sample 6 showed evidence of severe surface cracking by light microscopic examination. The appearance of the cracked layer was not always apparent when the specimens were examined in a wet condition but were dramatically evident in dry segments of identical areas, Figure 1 & 2. However, one sample did show evidence of a cracked layer when wet and dry, Figure 3. The cracked surface layer appeared blue when examined against a light colored background, Figure 4.

In histological sections of sample 6, a cracked surface layer measuring 3.0-4.5 microns was seen, accounting for approximately 8.5% of the total cross-sectional area. This layer was birefringent when examined under polarized light microscopy. Phloxine stain had completely penetrated the cracked layer, Figure 5, or was confined to the periphery of the surface layer, Figure 6. Particles of blue dye were evident within the cracked layer, Figure 5. There was no evidence of migration of particles from the cracked surface layer into the surrounding tissue.

DISCUSSION

In this study, it was shown that a 5-0 PROLENE suture in residence within a human vascular graft for 7 years displayed surface cracking. Other specimens of size 3-0 and 4-0 in this study from cardiovasular tissue specimens did not show surface cracking. The depth of the cracking in sample #6 was 3.0 - 4.5 microns in thickness which is consistent with other specimens, from previous samples up to 6 years post-op, ERF 84-132. This additional evidence from a 7 year specimen suggests no increase in thickness

of the cracked layer over time. The cracked layer appeared blue in gross specimens and blue dye particles were evident in histological sections of the layer. This would indicate that the layer is dyed PROLENE polymer and not an isolated protein coating on the strands.

Suture samples in this study were examined in a wet and dry condition to test the hypothesis that the cracking may be an artifact of drying. In most cases, it was difficult to visualize cracking on the surface when sutures were examined wet. This phenomenon may be related to the refractive index of the media in which the samples were examined, namely water. However, in several areas, of sample 6, cracking could be seen in both wet and dry conditions. The cracked layer was always more evident and dramatic in air dry specimens.

An average of the tensile strength measurements of samples in this study show a loss of strength for all materials tested. The breaking strength remaining for size 3-0 was 76.5%, size 4-0 98.25%, and size 5-0 76%. In some cases, however, individual samples of size 3-0 and 4-0 were stronger than control samples of identical size. All samples for breaking strength evaluation were carefully examined for surface defects prior to Instron testing. Those with obvious nicks or gouges were not tested. This breaking strength data must be viewed with caution since damage to strands during removal may have occurred despite efforts to prevent it.

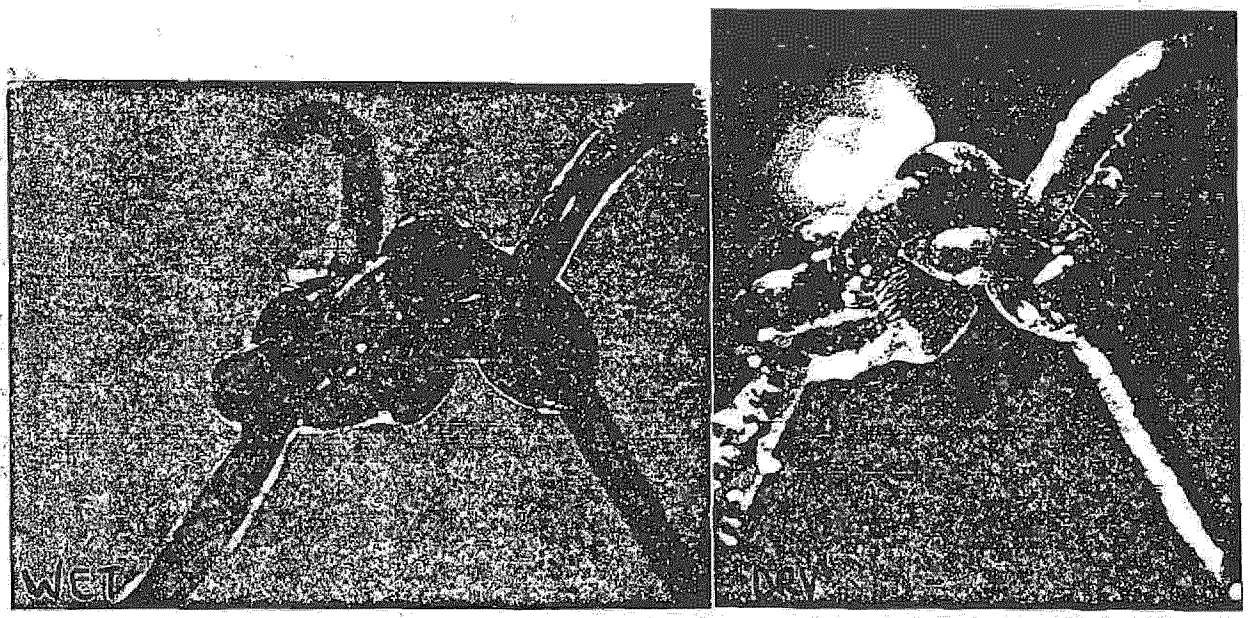

Figure 1 - Knot from sample 6 examined under wet and dry conditions. Cracking is more readily apparent in dry samples, 7 years size 5-0, magnification x40.

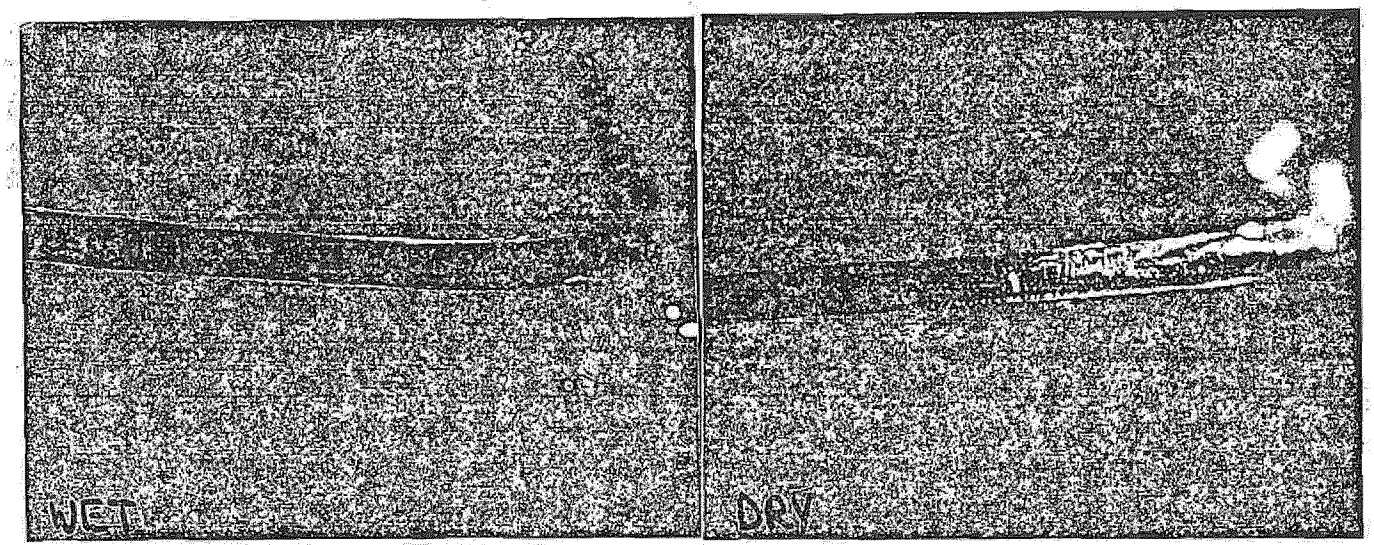

Figure 2 - Strand from sample 6 examined under wet and dry conditions. Cracking is more readily apparent in dry samples, 7 years, size 5-0, magnification X40.

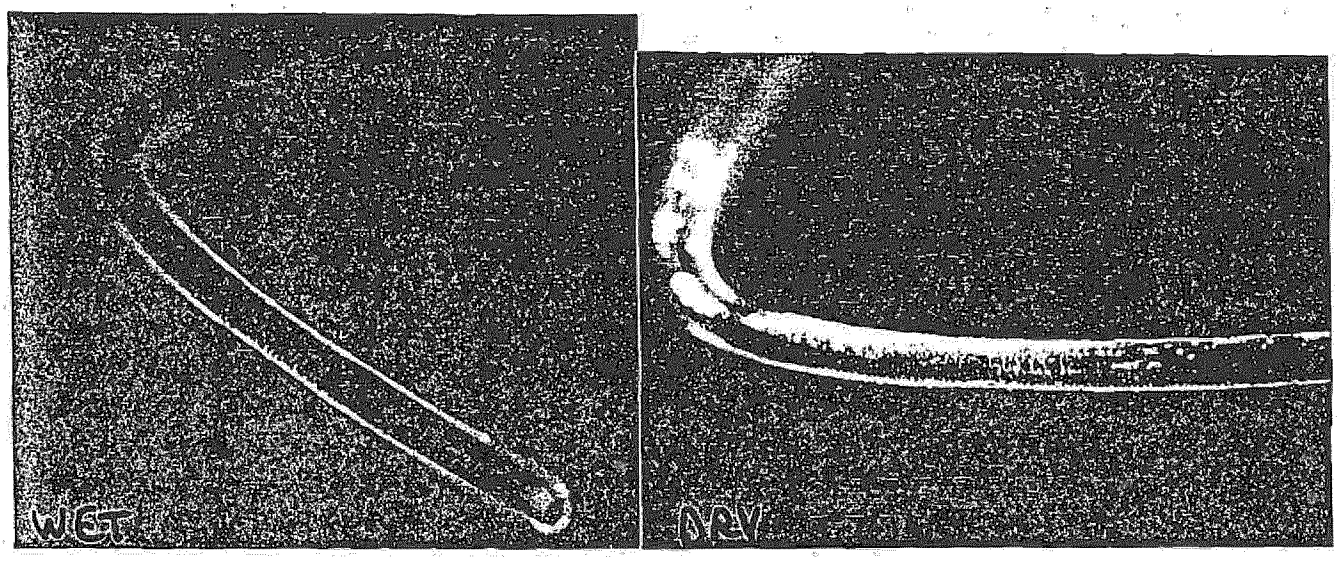

Figure 3 - Sample 6 examined under wet conditions showing some evidence of surface cracking which is more dramatic in the dry sample, 7 years, size 5-0, magnification x40.

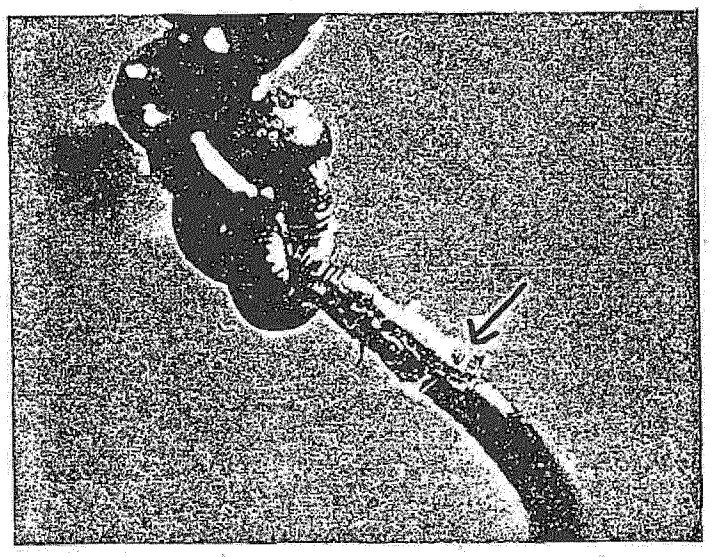

Figure 4 - Sample 6 photographed against a white background showing the blue color of the cracked surface layer, 7 years, size 5-0, magnification x40.

Figure 5 - Histological longitudinal sections of PROLENE from sample 6, block A, Phloxine stained. A 3.0-4.5 micron cracked surface layer is birefringent when viewed with polarized light, magnification x300.

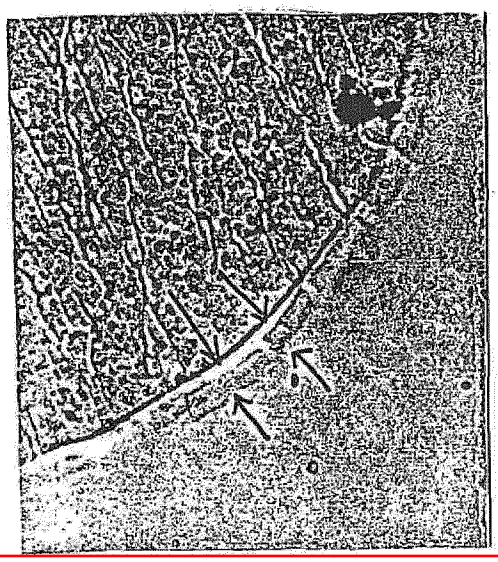

Figure 6 - Histological cross-section of sample 6, block D, Phloxine stained. Pink staining is limited to the periphery of the cracked layer in some areas. Blue dye particles can be seen within the cracked layer, magnification x1100.